



# wwPDB X-ray Structure Validation Summary Report ⓘ

Jan 24, 2021 – 02:32 PM EST

PDB ID : 3BGA  
Title : Crystal structure of beta-galactosidase from *Bacteroides thetaiotaomicron* VPI-5482  
Authors : Kumaran, D.; Burley, S.K.; Swaminathan, S.; New York SGX Research Center for Structural Genomics (NYSGXRC)  
Deposited on : 2007-11-26  
Resolution : 2.10 Å(reported)

This is a wwPDB X-ray Structure Validation Summary Report for a publicly released PDB entry.

We welcome your comments at [validation@mail.wwpdb.org](mailto:validation@mail.wwpdb.org)

A user guide is available at

<https://www.wwpdb.org/validation/2017/XrayValidationReportHelp>

with specific help available everywhere you see the ⓘ symbol.

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The following versions of software and data (see [references ⓘ](#)) were used in the production of this report:

MolProbity : 4.02b-467  
Mogul : 1.8.5 (274361), CSD as541be (2020)  
Xtriage (Phenix) : 1.13  
EDS : 2.16  
Percentile statistics : 20191225.v01 (using entries in the PDB archive December 25th 2019)  
Refmac : 5.8.0158  
CCP4 : 7.0.044 (Gargrove)  
Ideal geometry (proteins) : Engh & Huber (2001)  
Ideal geometry (DNA, RNA) : Parkinson et al. (1996)  
Validation Pipeline (wwPDB-VP) : 2.16

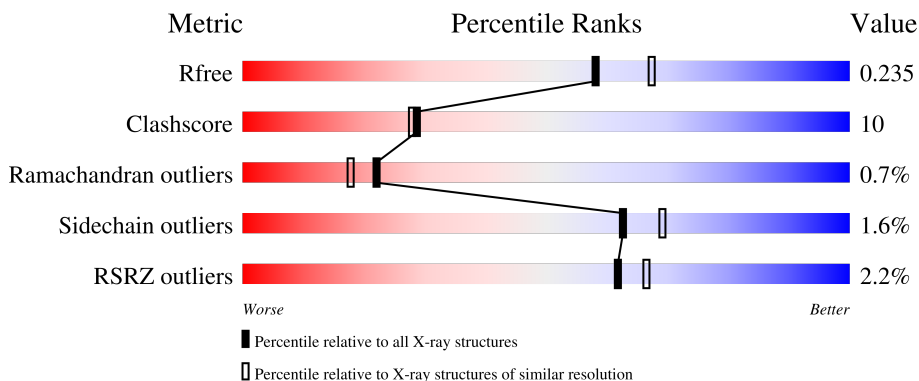
# 1 Overall quality at a glance

The following experimental techniques were used to determine the structure:

*X-RAY DIFFRACTION*

The reported resolution of this entry is 2.10 Å.

Percentile scores (ranging between 0-100) for global validation metrics of the entry are shown in the following graphic. The table shows the number of entries on which the scores are based.



Metric	Whole archive (#Entries)	Similar resolution (#Entries, resolution range(Å))
$R_{free}$	130704	5197 (2.10-2.10)
Clashscore	141614	5710 (2.10-2.10)
Ramachandran outliers	138981	5647 (2.10-2.10)
Sidechain outliers	138945	5648 (2.10-2.10)
RSRZ outliers	127900	5083 (2.10-2.10)

The table below summarises the geometric issues observed across the polymeric chains and their fit to the electron density. The red, orange, yellow and green segments of the lower bar indicate the fraction of residues that contain outliers for  $\geq 3$ , 2, 1 and 0 types of geometric quality criteria respectively. A grey segment represents the fraction of residues that are not modelled. The numeric value for each fraction is indicated below the corresponding segment, with a dot representing fractions  $\leq 5\%$ . The upper red bar (where present) indicates the fraction of residues that have poor fit to the electron density. The numeric value is given above the bar.

Mol	Chain	Length	Quality of chain
1	A	1010	 2% 79% 19% ..
1	B	1010	 2% 79% 19% ..

## 2 Entry composition [i](#)

There are 5 unique types of molecules in this entry. The entry contains 17243 atoms, of which 0 are hydrogens and 0 are deuteriums.

In the tables below, the ZeroOcc column contains the number of atoms modelled with zero occupancy, the AltConf column contains the number of residues with at least one atom in alternate conformation and the Trace column contains the number of residues modelled with at most 2 atoms.

- Molecule 1 is a protein called Beta-galactosidase.

Mol	Chain	Residues	Atoms						ZeroOcc	AltConf	Trace
			Total	C	N	O	S	Se			
1	A	1003	8064	5124	1390	1516	14	20	0	0	0
1	B	1000	8034	5109	1379	1512	14	20	0	0	0

There are 22 discrepancies between the modelled and reference sequences:

Chain	Residue	Modelled	Actual	Comment	Reference
A	21	MSE	-	expression tag	UNP Q8A799
A	22	SER	-	expression tag	UNP Q8A799
A	23	LEU	-	expression tag	UNP Q8A799
A	1023	GLU	-	expression tag	UNP Q8A799
A	1024	GLY	-	expression tag	UNP Q8A799
A	1025	HIS	-	expression tag	UNP Q8A799
A	1026	HIS	-	expression tag	UNP Q8A799
A	1027	HIS	-	expression tag	UNP Q8A799
A	1028	HIS	-	expression tag	UNP Q8A799
A	1029	HIS	-	expression tag	UNP Q8A799
A	1030	HIS	-	expression tag	UNP Q8A799
B	21	MSE	-	expression tag	UNP Q8A799
B	22	SER	-	expression tag	UNP Q8A799
B	23	LEU	-	expression tag	UNP Q8A799
B	1023	GLU	-	expression tag	UNP Q8A799
B	1024	GLY	-	expression tag	UNP Q8A799
B	1025	HIS	-	expression tag	UNP Q8A799
B	1026	HIS	-	expression tag	UNP Q8A799
B	1027	HIS	-	expression tag	UNP Q8A799
B	1028	HIS	-	expression tag	UNP Q8A799
B	1029	HIS	-	expression tag	UNP Q8A799
B	1030	HIS	-	expression tag	UNP Q8A799

- Molecule 2 is MAGNESIUM ION (three-letter code: MG) (formula: Mg).

Mol	Chain	Residues	Atoms	ZeroOcc	AltConf
2	B	1	Total Mg 1 1	0	0
2	A	1	Total Mg 1 1	0	0

- Molecule 3 is SODIUM ION (three-letter code: NA) (formula: Na).

Mol	Chain	Residues	Atoms	ZeroOcc	AltConf
3	B	2	Total Na 2 2	0	0
3	A	2	Total Na 2 2	0	0

- Molecule 4 is CHLORIDE ION (three-letter code: CL) (formula: Cl).

Mol	Chain	Residues	Atoms	ZeroOcc	AltConf
4	B	1	Total Cl 1 1	0	0
4	A	1	Total Cl 1 1	0	0

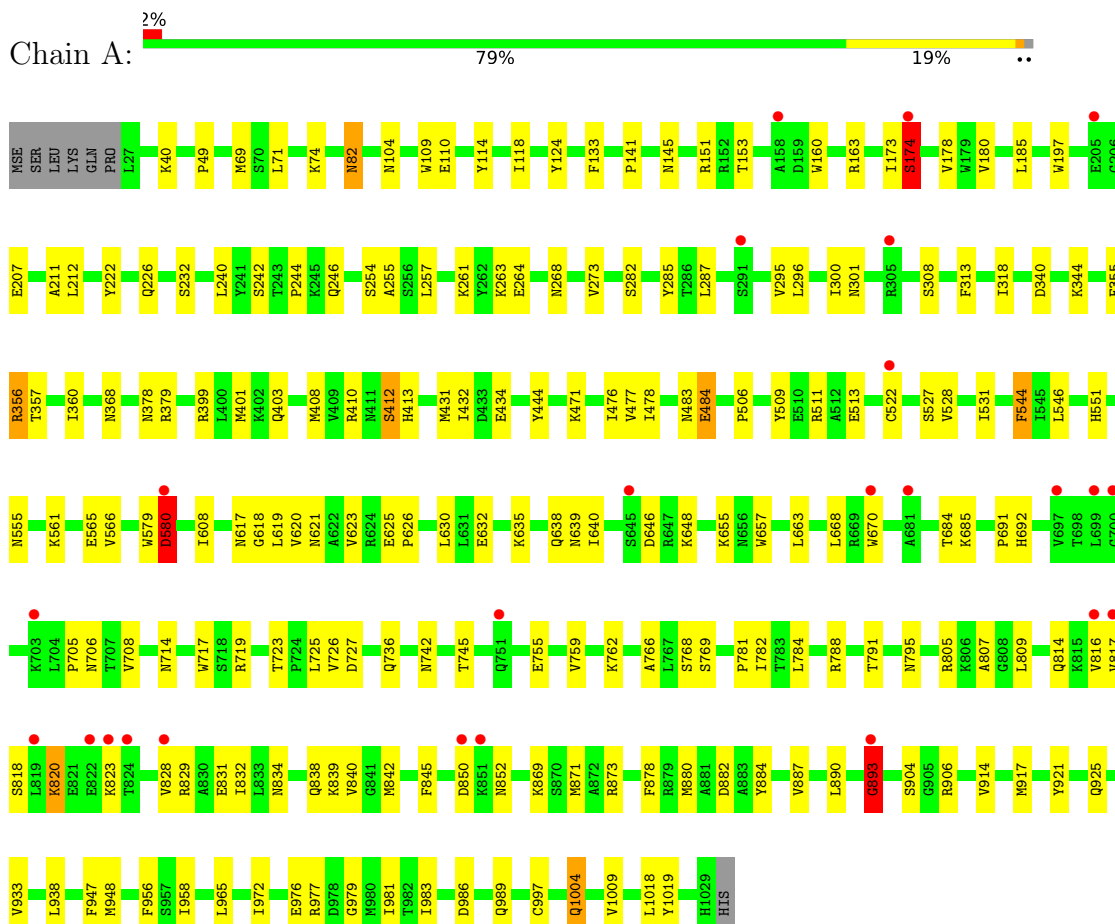
- Molecule 5 is water.

Mol	Chain	Residues	Atoms	ZeroOcc	AltConf
5	A	563	Total O 563 563	0	0
5	B	574	Total O 574 574	0	0

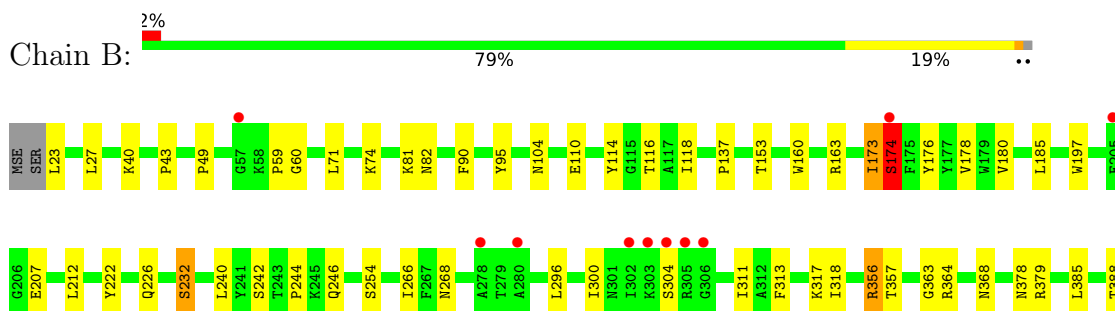
### 3 Residue-property plots [i](#)

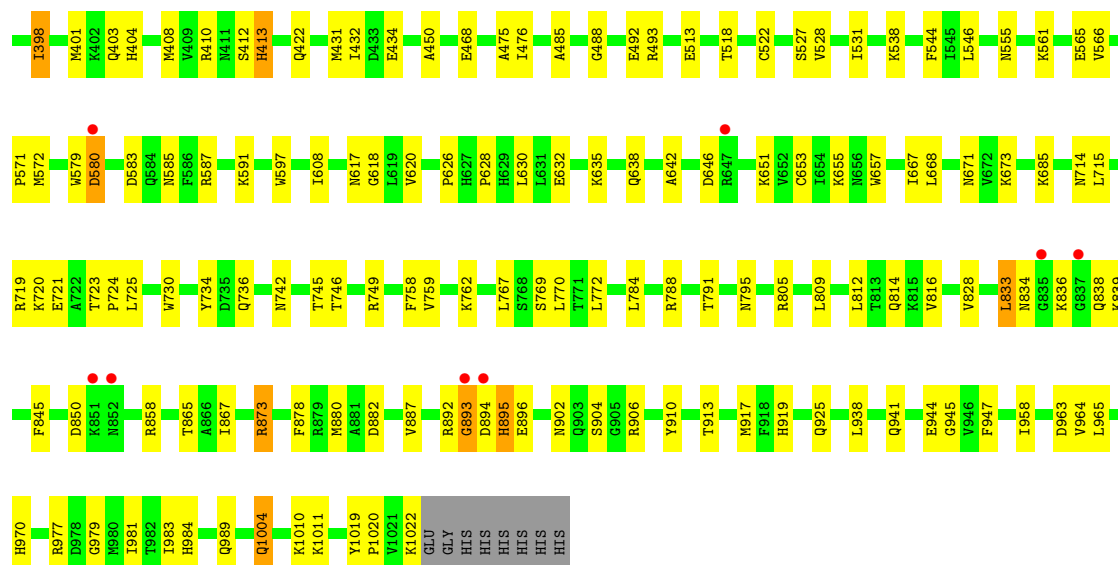
These plots are drawn for all protein, RNA, DNA and oligosaccharide chains in the entry. The first graphic for a chain summarises the proportions of the various outlier classes displayed in the second graphic. The second graphic shows the sequence view annotated by issues in geometry and electron density. Residues are color-coded according to the number of geometric quality criteria for which they contain at least one outlier: green = 0, yellow = 1, orange = 2 and red = 3 or more. A red dot above a residue indicates a poor fit to the electron density ( $RSRZ > 2$ ). Stretches of 2 or more consecutive residues without any outlier are shown as a green connector. Residues present in the sample, but not in the model, are shown in grey.

#### • Molecule 1: Beta-galactosidase



#### • Molecule 1: Beta-galactosidase





## 4 Data and refinement statistics

Property	Value	Source
Space group	P 1 21 1	Depositor
Cell constants a, b, c, $\alpha$ , $\beta$ , $\gamma$	88.33Å 138.86Å 102.82Å 90.00° 109.73° 90.00°	Depositor
Resolution (Å)	49.76 – 2.10 49.76 – 2.09	Depositor EDS
% Data completeness (in resolution range)	84.7 (49.76-2.10) 84.0 (49.76-2.09)	Depositor EDS
$R_{merge}$	0.08	Depositor
$R_{sym}$	(Not available)	Depositor
$\langle I/\sigma(I) \rangle$ <sup>1</sup>	0.50 (at 2.08Å)	Xtrriage
Refinement program	CNS 1.1	Depositor
R, $R_{free}$	0.200 , 0.234 0.200 , 0.235	Depositor DCC
$R_{free}$ test set	5795 reflections (4.91%)	wwPDB-VP
Wilson B-factor (Å <sup>2</sup> )	18.2	Xtrriage
Anisotropy	0.737	Xtrriage
Bulk solvent $k_{sol}$ (e/Å <sup>3</sup> ), $B_{sol}$ (Å <sup>2</sup> )	0.31 , 44.7	EDS
L-test for twinning <sup>2</sup>	$\langle  L  \rangle = 0.46$ , $\langle L^2 \rangle = 0.29$	Xtrriage
Estimated twinning fraction	No twinning to report.	Xtrriage
$F_o, F_c$ correlation	0.93	EDS
Total number of atoms	17243	wwPDB-VP
Average B, all atoms (Å <sup>2</sup> )	25.0	wwPDB-VP

Xtrriage's analysis on translational NCS is as follows: *The largest off-origin peak in the Patterson function is 3.68% of the height of the origin peak. No significant pseudotranslation is detected.*

<sup>1</sup>Intensities estimated from amplitudes.

<sup>2</sup>Theoretical values of  $\langle |L| \rangle$ ,  $\langle L^2 \rangle$  for acentric reflections are 0.5, 0.333 respectively for untwinned datasets, and 0.375, 0.2 for perfectly twinned datasets.

## 5 Model quality [i](#)

### 5.1 Standard geometry [i](#)

Bond lengths and bond angles in the following residue types are not validated in this section: NA, MG, CL

The Z score for a bond length (or angle) is the number of standard deviations the observed value is removed from the expected value. A bond length (or angle) with  $|Z| > 5$  is considered an outlier worth inspection. RMSZ is the root-mean-square of all Z scores of the bond lengths (or angles).

Mol	Chain	Bond lengths		Bond angles	
		RMSZ	# Z  >5	RMSZ	# Z  >5
1	A	0.36	0/8256	0.65	1/11168 (0.0%)
1	B	0.35	0/8222	0.64	5/11122 (0.0%)
All	All	0.36	0/16478	0.65	6/22290 (0.0%)

There are no bond length outliers.

The worst 5 of 6 bond angle outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
1	A	893	GLY	N-CA-C	7.27	131.28	113.10
1	B	893	GLY	N-CA-C	5.46	126.75	113.10
1	B	81	LYS	N-CA-C	-5.29	96.72	111.00
1	B	173	ILE	CA-C-N	-5.27	105.60	117.20
1	B	173	ILE	C-N-CA	5.00	134.21	121.70

There are no chirality outliers.

There are no planarity outliers.

### 5.2 Too-close contacts [i](#)

In the following table, the Non-H and H(model) columns list the number of non-hydrogen atoms and hydrogen atoms in the chain respectively. The H(added) column lists the number of hydrogen atoms added and optimized by MolProbity. The Clashes column lists the number of clashes within the asymmetric unit, whereas Symm-Clashes lists symmetry-related clashes.

Mol	Chain	Non-H	H(model)	H(added)	Clashes	Symm-Clashes
1	A	8064	0	7787	159	0
1	B	8034	0	7782	148	0
2	A	1	0	0	0	0
2	B	1	0	0	0	0

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Mol	Chain	Non-H	H(model)	H(added)	Clashes	Symm-Clashes
3	A	2	0	0	0	0
3	B	2	0	0	0	0
4	A	1	0	0	0	0
4	B	1	0	0	0	0
5	A	563	0	0	8	0
5	B	574	0	0	14	0
All	All	17243	0	15569	307	0

The all-atom clashscore is defined as the number of clashes found per 1000 atoms (including hydrogen atoms). The all-atom clashscore for this structure is 10.

The worst 5 of 307 close contacts within the same asymmetric unit are listed below, sorted by their clash magnitude.

Atom-1	Atom-2	Interatomic distance (Å)	Clash overlap (Å)
1:A:173:ILE:HG13	1:A:174:SER:N	1.77	1.00
1:B:431:MSE:HE3	1:B:476:ILE:CG1	1.93	0.97
1:B:723:THR:HG22	1:B:725:LEU:H	1.25	0.95
1:A:714:ASN:HD21	1:A:736:GLN:HE21	1.12	0.94
1:B:431:MSE:HE3	1:B:476:ILE:HG13	1.49	0.93

There are no symmetry-related clashes.

## 5.3 Torsion angles [i](#)

### 5.3.1 Protein backbone [i](#)

In the following table, the Percentiles column shows the percent Ramachandran outliers of the chain as a percentile score with respect to all X-ray entries followed by that with respect to entries of similar resolution.

The Analysed column shows the number of residues for which the backbone conformation was analysed, and the total number of residues.

Mol	Chain	Analysed	Favoured	Allowed	Outliers	Percentiles
1	A	1001/1010 (99%)	954 (95%)	41 (4%)	6 (1%)	25 21
1	B	998/1010 (99%)	948 (95%)	43 (4%)	7 (1%)	22 18
All	All	1999/2020 (99%)	1902 (95%)	84 (4%)	13 (1%)	22 18

5 of 13 Ramachandran outliers are listed below:

Mol	Chain	Res	Type
1	A	412	SER
1	B	412	SER
1	A	893	GLY
1	B	513	GLU
1	B	895	HIS

### 5.3.2 Protein sidechains [i](#)

In the following table, the Percentiles column shows the percent sidechain outliers of the chain as a percentile score with respect to all X-ray entries followed by that with respect to entries of similar resolution.

The Analysed column shows the number of residues for which the sidechain conformation was analysed, and the total number of residues.

Mol	Chain	Analysed	Rotameric	Outliers	Percentiles	
1	A	854/840 (102%)	844 (99%)	10 (1%)	71	77
1	B	852/840 (101%)	834 (98%)	18 (2%)	53	59
All	All	1706/1680 (102%)	1678 (98%)	28 (2%)	62	69

5 of 28 residues with a non-rotameric sidechain are listed below:

Mol	Chain	Res	Type
1	B	356	ARG
1	B	522	CYS
1	B	941	GLN
1	B	398	ILE
1	B	413	HIS

Sometimes sidechains can be flipped to improve hydrogen bonding and reduce clashes. 5 of 49 such sidechains are listed below:

Mol	Chain	Res	Type
1	A	989	GLN
1	B	301	ASN
1	B	929	ASN
1	B	85	ASN
1	B	328	HIS

### 5.3.3 RNA [i](#)

There are no RNA molecules in this entry.

## 5.4 Non-standard residues in protein, DNA, RNA chains [i](#)

There are no non-standard protein/DNA/RNA residues in this entry.

## 5.5 Carbohydrates [i](#)

There are no monosaccharides in this entry.

## 5.6 Ligand geometry [i](#)

Of 8 ligands modelled in this entry, 8 are monoatomic - leaving 0 for Mogul analysis.

There are no bond length outliers.

There are no bond angle outliers.

There are no chirality outliers.

There are no torsion outliers.

There are no ring outliers.

No monomer is involved in short contacts.

## 5.7 Other polymers [i](#)

There are no such residues in this entry.

## 5.8 Polymer linkage issues [i](#)

There are no chain breaks in this entry.

## 6 Fit of model and data [i](#)

### 6.1 Protein, DNA and RNA chains [i](#)

In the following table, the column labelled ‘#RSRZ > 2’ contains the number (and percentage) of RSRZ outliers, followed by percent RSRZ outliers for the chain as percentile scores relative to all X-ray entries and entries of similar resolution. The OWAB column contains the minimum, median, 95<sup>th</sup> percentile and maximum values of the occupancy-weighted average B-factor per residue. The column labelled ‘Q < 0.9’ lists the number of (and percentage) of residues with an average occupancy less than 0.9.

Mol	Chain	Analysed	<RSRZ>	#RSRZ>2	OWAB(Å <sup>2</sup> )	Q<0.9
1	A	983/1010 (97%)	0.06	25 (2%) 57 62	10, 24, 43, 55	0
1	B	980/1010 (97%)	-0.11	18 (1%) 68 72	11, 23, 39, 58	0
All	All	1963/2020 (97%)	-0.02	43 (2%) 62 66	10, 23, 41, 58	0

The worst 5 of 43 RSRZ outliers are listed below:

Mol	Chain	Res	Type	RSRZ
1	B	305	ARG	7.0
1	B	304	SER	5.3
1	B	306	GLY	4.4
1	B	303	LYS	4.4
1	A	819	LEU	3.7

### 6.2 Non-standard residues in protein, DNA, RNA chains [i](#)

There are no non-standard protein/DNA/RNA residues in this entry.

### 6.3 Carbohydrates [i](#)

There are no monosaccharides in this entry.

### 6.4 Ligands [i](#)

In the following table, the Atoms column lists the number of modelled atoms in the group and the number defined in the chemical component dictionary. The B-factors column lists the minimum, median, 95<sup>th</sup> percentile and maximum values of B factors of atoms in the group. The column labelled ‘Q < 0.9’ lists the number of atoms with occupancy less than 0.9.

Mol	Type	Chain	Res	Atoms	RSCC	RSR	B-factors( $\text{\AA}^2$ )	Q<0.9
3	NA	B	3	1/1	0.95	0.09	18,18,18,18	0
3	NA	A	4	1/1	0.98	0.07	15,15,15,15	0
3	NA	A	6	1/1	0.98	0.06	21,21,21,21	0
2	MG	A	1	1/1	0.98	0.10	10,10,10,10	0
2	MG	B	2	1/1	0.98	0.06	20,20,20,20	0
4	CL	B	8	1/1	0.99	0.04	14,14,14,14	0
3	NA	B	5	1/1	0.99	0.08	18,18,18,18	0
4	CL	A	7	1/1	0.99	0.07	12,12,12,12	0

## 6.5 Other polymers [i](#)

There are no such residues in this entry.